TCEQ Experimental Exemption
Annual Research Report 2006 – 2007

TCEQ Permit NO. WQ0003823000

Hornsby Bend Biosolids Management Plant
Long-term Study of the Ecological Impacts of Biosolids Land Application

Austin Water Utility
Hornsby Bend Biosolids Management Plant
Center for Environmental Research

Prepared by

Jody Slagle P.E.
Process Engineer, Hornsby Bend

Kevin M. Anderson
Coordinator, Center for Environmental Research

Natasha Rosofsky
Austin Water Utility

July 2007

Contents

I. REPORT SUMMARY 2006 – 2007

The current report reflects research activity under the Experimental Exemption for Permit WQ0003823000 for the period July 2006 – June 2007 and related information:

- A continuation of research on the effect of biosolids on soil ecology
- A discussion of the soil food web
- Records of land application of biosolids
- The results of a two-year study of the repellent effects of composted biosolids (i.e., Dillo Dirt) on fire ants at the Hornsby Bend site
- Background of the Hornsby Bend site and fields under the Experimental Exemption

The biodiversity at Hornsby Bend ranges from 370 bird species to many amphibians and reptiles

Marker for fire ant study plots – ant species are also monitored at Hornsby Bend

Rainfall gauge near Platt fields – the first six months of 2007 are the wettest on record for Hornsby Bend

Effects of 2006 drought on the Hornsby Bend hay fields – September 2006

Visitors entrance to Hornsby Bend ponds – the most popular birding site in the Austin area

UT graduate student teaching soil ecology to high school students at Hornsby Bend November 2006

II. Background and Rationale for Biosolids-Soil Ecology Study

The goals of this research effort are to add to current knowledge about the long-term safety, sustainability, and ecological impacts of applying Class B biosolids to land. Most of the existing research appears to be focused on nutrients, crop yields, and contaminants, but significantly, not on effects on soil biology. On both a national and global level, questions are being raised about the safety of biosolids reuse, particularly in terms of Class B biosolids. The National Biosolids Partnership has initiated efforts to address these concerns on a national level. Although there has been no formal public opposition to Austin's land application program, the City of Austin (the "City") and other local entities are very interested in furthering our knowledge of the effects, both positive and negative, of land application. From the City's perspective, it is more cost effective and environmentally beneficial to reuse biosolids through land application and composting than to landfill the material. In addition, biosolids application incorporates beneficial nutrients and organic material into agricultural soils and urban soils, particularly soils that have been degraded by farming and other human practices. Over the planned 10-year course of research, this project will endeavor to utilize crop productivity records, soil biodiversity indicators (i.e., the soil food web), and other parameters to address some of the ecological questions associated with biosolids.

The Hornsby Bend site offers a unique opportunity to support a biosolids research partnership between the University of Texas and the City to study the long-term ecological effects of biosolids application. In addition to land application of Class B biosolids and field irrigation with processed water, Hornsby Bend recycles all of Austin's and yard trimmings through composting with biosolids. The Hornsby Bend Plant has received numerous awards including twice winning the EPA's National First Place Award for Beneficial Reuse of Biosolids.

The Hornsby Bend site encompasses the following activities:

- All of Austin's sewage sludge is treated by anaerobic digestion.
- Methane produced in anaerobic digestion is used to heat digesters as well as to power a cogeneration plant onsite.

- Water extracted during sludge treatment is further treated by a sidestream facility and passed through three large ponds and an aquatic greenhouse before use in irrigation. These ponds create a unique habitat for migrating birds and are considered to be the best birdwatching site in Central Texas.
- Class B biosolids from anaerobic digestion are belt-pressed and used in land application or as an ingredient in composting.
- Biosolids land application fields include those applied annually at the site since 1986. These older fields are now applied every other year (bi-annually) in accordance with the Nutrient Management Plan. The Experimental Exemption fields are applied at 10, 20, and 30 dry tons per acre (DT/acre) and consist of adjacent agricultural land purchased by the City in 2000 to expand the onsite land application acreage. This additional acreage allows comparisons of application methods, including annual application for over 20 years, new application, and application at varying rates. This variation in application rates and practices is essential to achieve the goals of this study. Fields at the Hornsby Bend site include:

Fields in use since 1986	Acreage	Application Rate	Application Frequency
Tract B	27.1	9.8 DT/acre	Bi-annual
Sideroll	60		Currently not used
CP1E	9	9.8 DT/acre	Bi-annual
CP1W	32.7		Currently not used
CP2E	13.6	9.8 DT/acre	Bi-annual
CP2W	26.5		Currently not used
Admin/Pecan Orchard	15.6	9.8 DT/acre	Bi-annual
Tree Farm	8.7		Currently not used
CP 3	16.6	9.8 DT/acre	Bi-annual
CP 4	13.6		Currently not used
South Tract	40	9.8 DT/acre	Bi-annual
Fields under Experimental Exemption			
Platt 1	60.7	30 DT/acre	Annual
Platt 2	57.8	30 DT/acre	Annual
Platt 3	47.5	20 DT/acre	Annual
Platt 4	42.6	20 DT/acre	Annual
Platt 5	26	10 DT/acre	Annual
Platt 6	22	10 DT/acre	Annual
Tract C	28.8	10 DT/acre	Annual

Discussions with the University of Texas Integrative Biology Department emphasized the need for research into the long-term effects of biosolids land application on soil biology. Although much widespread research has been done on crop yield improvements following land application of biosolids, relatively little work appears to have been done on the impacts of biosolids applications on soil ecology. This research project accordingly implements a recently developed analytical framework for soil ecology, termed the "soil food web," as one of the tools for assessing the long-term impacts and sustainability of biosolids application. This report discusses the soil food web and analytical framework below in Section V.

III. Timeline of Biosolids Land Application by Hornsby Bend Research Partnership for the Annual Periods June - July

2008

Land application will continue at Hornsby Bend under the Experimental Exemption. The Exemption provides the needed flexibility to allow research into the varying rates and methods of land application that otherwise would be impossible to study.

The Hornsby Bend site is owned by the City's Austin Water Utility. As such, it is under the control of the Water Utility, which is responsible for land application and sponsors the related research. Land application and research at the Hornsby Bend site will continue as long as the permit and Experimental Exemption allow.

Soil Ecology research will continue on a regular basis, with one dedicated facility-wide sampling anticipated each year in conjunction with normal pre-application sampling.

The farm contract at Hornsby is designed to provide more coordination between the farmer and the research partnership, and it should allow more comprehensive data collection as needed. Significantly, the new farm contract provides funds for the soil and plant testing central to our research efforts.

2007

Research on the effect of biosolids on soil ecology continues under the Experimental Exemption.

Application of Unison Novel Broadleaf Herbicide to fields to control growth of broadleaf weeds on the Platt fields on March 20 and other Hornsby Bend fields on April 5.

Results of the two-year study, **"**Repellency of Red Imported Fire Ants (*Solenopsis invicta*) to Dillo Dirt, a Sewer Sludge-Based Compost Material," with Texas A&M Cooperative Extension entomologist Elizabeth Brown reveal sporadic differences, inconsistency over time, and the necessity of further testing to develop definite conclusions.

2006

Sampling of the permitted fields at Hornsby Bend was completed and includes analysis for soil food web characteristics and conventional nutrient criteria. First-year results indicate expected bacteria-dominated soils, which are desirable for grasses.

A Nutrient Management Plan set new recommended biosolids application rates for the fields not included in the Experimental Exemption based on nitrogen and phosphorous levels.

2005

The Experimental Exemption to is discontinued as a separate permit and incorporated into the Permit WQ0003823000. The Exemption now includes land only at Hornsby Bend (Platt fields 1-6 and Tract C).

UT-Austin collaborators decide to serve the Hornsby Bend Research Partnership in an advisory-only capacity based on the loss of the Webberville fields for research.

Farming of the Webberville site shifts from use of biosolids land application to traditional farming practices.

2004

Land application stops at the Webberville fields.

The Platt fields continue to be marked and mapped at the Hornsby Bend site.
A farming lease begins for the entire Hornsby Bend site, including the fields under the Experimental Exemption (for the Platt fields and Tract C) and the field under the permit.

Platt fields are sprigged with Bermuda grass for hay production.

A study of the repellent effects of composted biosolids (Dillo Dirt) on fire ants (*Solenopsis invicta*) with Texas A&M Cooperative Extension entomologist Elizabeth Brown begins.

2003

The Platt fields are marked and mapped at the Hornsby Bend site with 10-acre buffer zones for roadways and wells. These buffer zones serve as control sites, which receive no biosolids land application to allow comparisons with the application plots.

Vegetation is shredded on Platts 1, 2, 3, and 4, which formerly grew row crops unsuitable for hay. Hay is baled from Platts 5 and 6, which previously grew hay.

The Texas A&M soils laboratory analyzes soil samples before land application begins at the Platt fields, and University of Texas students conduct preliminary biological assays on the samples.

Fields at Hornsby Bend and Webberville receive biosolids land application.

Organic control treatments are studied on plots near Platt 6 related because of anecdotal accounts of fire ants disappearing from yards and park areas treated with biosolids compost (Dillo Dirt).

2002

Webberville fields are enlarged in keeping with traditional farming practices and are applied with three rates of biosolids across sorghum and feed corn crops.

The new Platt fields on the Hornsby Bend property are first marked into a number of large (25-30 acres) and small (1-4 meter^2) research fields and then readjusted into just six larger fields.

2001

The Experimental Exemption is granted by the (former) Texas Natural Resource Conservation Commission (TNRCC) to research the long-term effects of biosolids land application on soil biology. The Exemption includes offsite fields at Webberville as well as the Platt fields and Tract C field at Hornsby Bend.

Land application of Class B biosolids begins to approximately 600 acres of farmland at Webberville (not part of the Hornsby Bend site) and includes multiple sets of one-acre research plots of land in varying application rates under the Experimental Exemption.

2000

The City purchases adjacent agricultural land, expanding the Hornsby Bend site. The new acreage is not yet farmed.

1988

The Center for Environmental Research (CER) is established at the Hornsby Bend site.

1987

Biosolids composting begins as a pilot program.

1986

Hornsby Bend is rebuilt as a reuse/recycling facility for all of Austin's sewage sludge, including use of biosolids land application on permitted agricultural fields onsite.

1957

Hornsby Bend Biosolids Management Plant is established and contains sludge treatment ponds.

Land application with the Terragator on Platt fields

Land Application January 2007 before rain – note green vegetation response

A farmer contracts to mow and bale hay at Hornsby Bend

First cutting of hay on Platt fields – April 2007

Platt hay fields July 2006

Land application July 2007

IV. Biosolids Research Partnership

The research partnership and their contributions for this project are as follows:

Hornsby Bend Biosolids Management Plant

Jody Slagle, P.E., Biosolids Reuse Engineer and Research Project Manager

- Acquired funding for land application
- Provides research support
- Coordinates hauling and land application
- Implemented land infrastructure improvements
- Supervises University of Texas undergraduate interns and students

The Center for Environmental Research

Kevin M. Anderson, CER Coordinator and Research Project Manager

- Secured funding for position from Austin Water Utility and grants
- Cultivated partnership with University of Texas and Texas A&M University for research and education about urban sustainability and ecology
- Manages biosolids research partnership with university participants
- Supervises University of Texas undergraduate interns and students

Soil Food Web, Inc. Laboratory

- Provides qualitative and quantitative analyses of soil and compost for soil food web criteria

Texas Plant & Soil Lab, Inc.

- Provides conventional soil analyses

University of Texas

- Provided GIS support through the Geography Department
- Consultation services provided by Drs. Richard H. Richardson and Patricia Q. Richardson, Department of Integrative Biology

Travis County Cooperative Extension

Elizabeth Brown, Entomologist

- Conducted fire ant research studies

V. The Soil Food Web and Preliminary Results

The soil food web conceptualizes soil biology as a complex, interdependent system of trophic levels (scales). Biological activity cycles energy and nutrients among trophic levels from photosynthesizing organisms (e.g., plants), decomposing organisms (e.g., bacteria and fungi), and higher-level predators (e.g., protozoa, nematodes, etc.). This cycling of energy and nutrients within the soil controls many of the conditions for plant growth. The abundance, activity and diversity of soil life are good indicators of a healthy ecosystem (i.e., one in which nutrient cycling and productivity are optimized). Studies of the soil food webs in different ecosystems have suggested that food web compositions are different for different ecosystems. Hence, grassland soils have been found to be dominated by bacteria, whereas forest soils are dominated by fungi.

Soil food web analyses evaluate active and total populations of bacteria and fungi, as well as numbers and diversity of organisms like protozoa, nematodes, and microarthropods. Specialized laboratory and microscopy techniques are required for this ecosystem-based research, some of which have been developed by Dr. Elaine Ingham's Soil Food Web laboratory in Corvallis, Oregon.

The soil food web analyses completed in 2006 are the first round of a long-term monitoring effort at Hornsby Bend. As such, this interim project report does not draw any conclusions about the analytical results generated to date. Subsequent analyses may reveal stronger trends and correlations among factors, but trends are not expected to become apparent until five years of data is compiled. Sampling for 2007 is beginning in July, so results are not included in this report.

Termite activity on Platt fields

Harvester ants moving pellets of biosolids near mound

Worm activity through compacted soil

Ant activity brings orange subsoil to surface

Velvet ant on parched soil

Fungus growing in Dillo Dirt compost